

1 **Investigation of Electronic Document Management**
2 **applications in the Construction Projects: Case Study in**
3 **Jordan**

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8 **Abstract.** Document Management System (DMS) is always known to be vital
9 for management of the complexity of construction projects. This study aims at
10 investigating the opinions of DMS practitioners regarding the use of Electronic
11 Document Management System (EDMS) in construction projects. A
12 questionnaire survey was conducted with 91 respondents involved in the
13 construction projects. The respondents were asked to evaluate the extent,
14 motivations and challenges of applying EDMS in the construction projects in
15 Jordan. According to the survey results only 8.8 % of the respondents described
16 the document system in their construction projects as mostly electronic, while
17 38.5% described their document system as using almost similar percentage of
18 electronic and paper-based documents. The results also showed that the top
19 motivation to the application of EDMS in the construction projects is the
20 improvement of search and retrieval of information, while the top challenge is
21 the high expected financial cost of EDMS. This study helps to evaluate the
22 existing DMS, and investigate the motivations, challenges and opportunities to
23 improve EDMS implementation and application in the construction projects.

24 **Keywords:** Document Management, Construction Management, Construction
25 Projects, Electronic Document Management System.

26 **1 Introduction**

27 In construction projects, the traditional manual methods of filing are still common
28 especially in small and medium size construction companies [1]. These methods were
29 proven not effective for information management, because they require previous
30 knowledge and understanding of document content, high capabilities and time
31 consumption from the seeker [2]. Many organizations have claimed saving time and
32 efforts, increasing productivity and profitability, and improving coordination and
33 collaboration among end-users by implementing effective EDMS [3].

34 Some factors in the construction projects may prevent the successful application of
35 EDMS such as the complexity, the diversity of work performers, the non-repetitive
36 nature of processes, the time and cost pressure, difficulty of systems' integration and

37 the need to make changes to the routine procedures of work [4, 5, 6 and 7]. A research
38 by Björk has investigated the use of internet-based DMS in the project-based
39 construction industry [8]. The results showed that among the most important challenges
40 for applying EDMS successfully are the complexity of contents' structure, the use of
41 paper documents in parallel with electronic ones and the difficulty of measuring the
42 benefits of applying the system.

43 This research seeks to investigate existing DMS in construction companies in
44 Jordan. The research will highlight the use of the system, and the motivations and
45 challenge to its successful application in the construction projects.

46 **2 Literature Review**

47 A paper by Van Wormer and Larkin was designed to provide a guide in the selection,
48 development, and deployment of an Electronic Data Management system used for
49 Engineering, Construction and owner operators [9]. The authors stated that the use for
50 electronic document and content management has been motivated and become more
51 advanced with the availability of free or low cost cloud collaboration solutions along
52 with the wider use of 3D design and BIM models. They argued that the traditional
53 document control methods no longer work efficiently or with flexibility as the new
54 advanced technological solutions.

55 Alshibly et al. have investigated the critical success factors that affect EDMS
56 applications in government agencies [10]. Through a questionnaire survey, a list of 37
57 factors grouped into six categories were evaluated. The study supported that a
58 comprehensive list of critical success factors should not only include the factors focused
59 on the system, but should also include top management support, resource availability,
60 training and involvement, technological readiness and work environment and culture.
61 The results showed that the factor related to the system is the most important for
62 successful implementation of EDMS, followed by top management support and
63 resource availability.

64 Research by Al Qady and Kandil has presented a technique to improve managing
65 knowledge contained in construction documents [2 and 11]. Their research attempts to
66 improve document categorization and retrieval by analyzing the contents of documents
67 using natural language processing. Techniques were used to extract semantic
68 knowledge from construction contract documents that can be used to improve EDMS
69 functions. The research have presented a method to overcome the restrictions imposed
70 by the traditional supervised learning text classifiers, which require a comprehensive
71 training set to classify new instance. An unsupervised learning method was used in this
72 research to automatically cluster documents together based on textual similarities.

73 Research conducted by Rujiranyong and Shi presented a design of a project-
74 oriented database that consists of 26 tables that are connected to each other through
75 primary and secondary keys [12]. Using data processing tools such as data mining,
76 analysis and reporting will help to add meaning to data and transform them into
77 knowledge that is more useful in problem solving and decision making. This will
78 increase its value to other users. The presented data warehouse can maintain data from

79 different existing software systems. It associates data of each project so that a user can
80 retrieve information combined with required background information of the related
81 project.

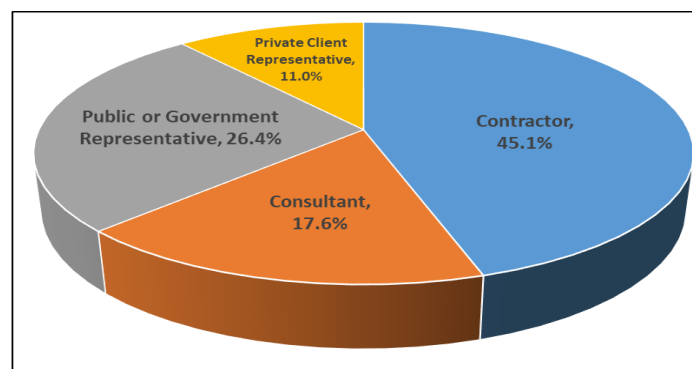
82 **3 Results and Discussions of the Questionnaire Survey**

83 The questionnaire survey was designed to target engineers recently involved in
84 construction projects in Jordan. The questionnaire was split into three main sections.
85 The first section seeks general information about the respondents and the projects they
86 are involved in. The second section investigates the respondents' evaluation of the
87 DMS used in the projects they are involved in whether the system is mainly paper or
88 electronic-based. Finally, the third part asks the respondents to provide their assessment
89 and expectations of the motivations and challenges for implementing EDMS in the
90 construction projects.

91 The questionnaire uses five-point Likert-scale to collect the respondents' evaluation
92 of the organization of existing DMS, and the motivations and challenges of the
93 application of EDMS in the construction projects.

94 **3.1 Profile of Respondents and Projects**

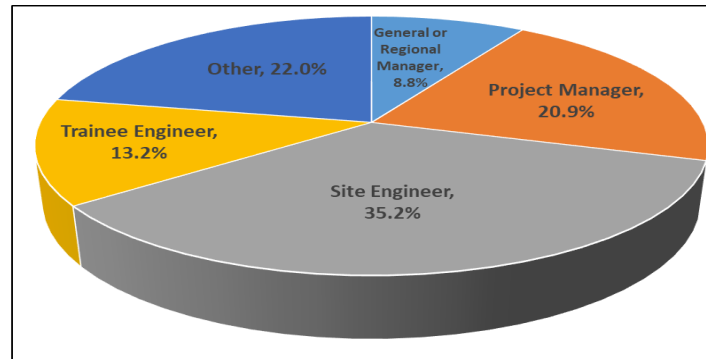
95 The questionnaires were distributed and filled electronically using Google Forms. Most
96 of the sample individuals were contacted either by calling or by direct visits to
97 encourage them to fill the questionnaire. The final number of effective responses equals
98 to 91. Fig. 1 shows the categorization of respondents by the role of their organizations
99 in the construction projects, while Fig. 2 shows the role of respondents in their
100 organizations.



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Fig. 1. Percentage of respondents by type of their organizations.



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Fig. 2. Percentages of respondents by their jobs in the construction projects.

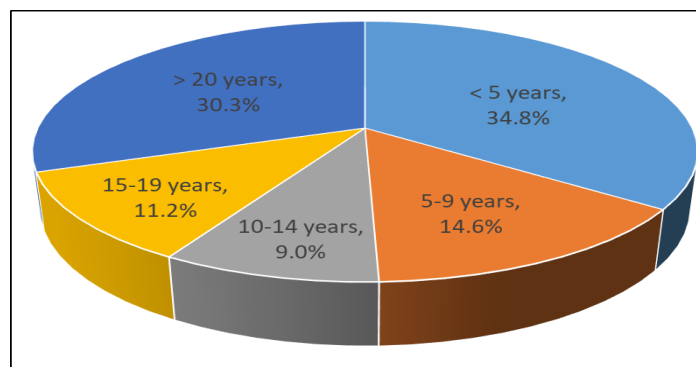
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More than half of the respondents have over 10 years of professional experience as shown in Fig. 3. Figures 2 and 3 indicate in general that the respondents have professional experience and placed in positions that makes their response a useful source of data for this study.



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Fig. 3. Percentages of respondents by their years of experience.

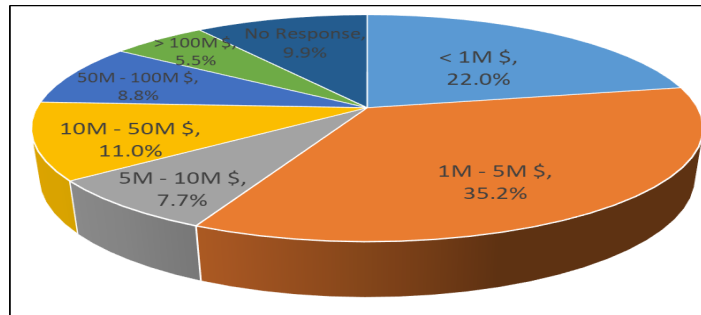
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Majority of the projects (57.2%) that the respondents involved in are with a financial size less than five million US dollars. Fig. 4 illustrates the percentages of the construction projects that the respondents involved in by the financial size of these projects.



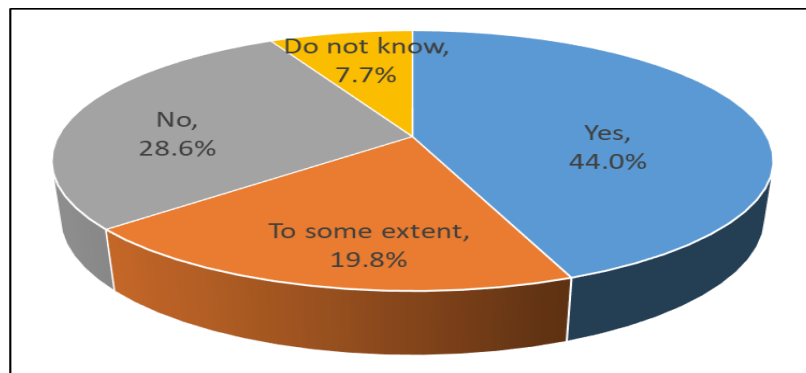
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Fig. 4. Percentages of respondents by their project financial size.

117 3.2 DMS Evaluation

118 The questionnaire participants were asked to give their opinion if there is EDMS
 119 applied in the construction project they are involved in. The results showed that 63.8%
 120 agree that there is EDMS applied in the construction projects they are involved in as
 121 presented in Fig. 5.

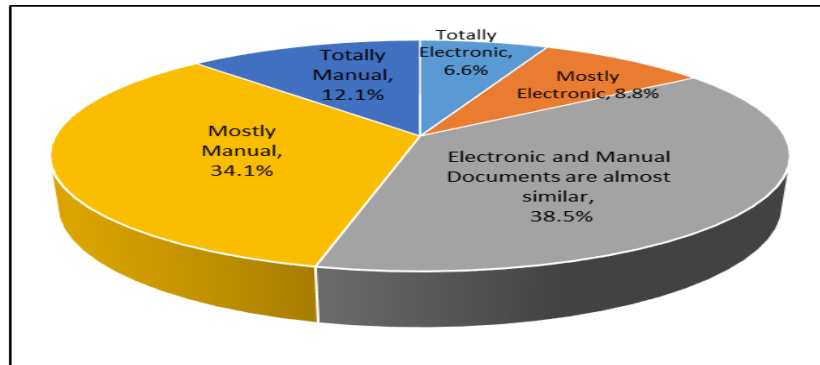


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Fig. 5. Percentages of respondents by the application of EDMS in their projects.

124 Also, the respondents were asked to evaluate the extent of using electronic-based
 125 contents compared to paper-based contents in their projects. Fig. 6 shows the response
 126 to the evaluation of this questions.



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Fig. 6. Respondents' evaluation of the extent of electronic and paper-based documents in the construction projects.

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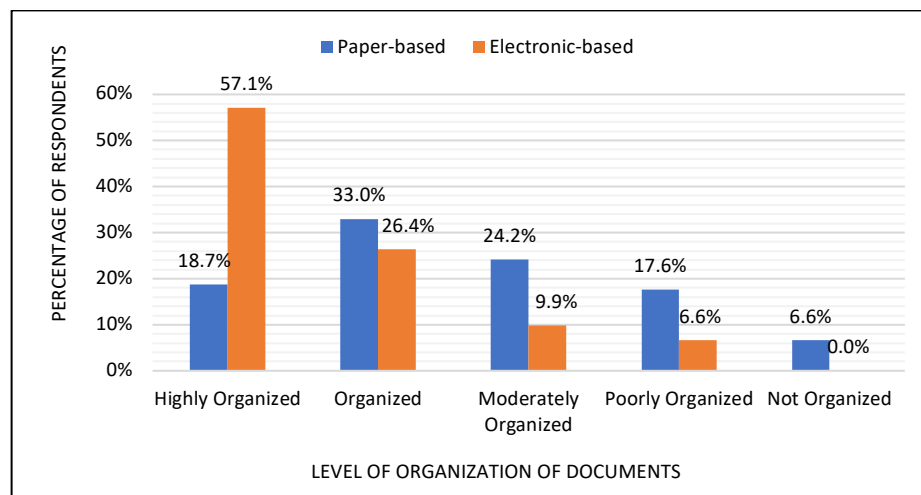
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The results from Fig. 6 show that paper-based contents are more commonly used in the construction projects than electronic contents. Major percentage of the respondents (38.5%) indicated that electronic and manual-based contents are used almost equally in their construction projects.

Furthermore, Fig. 7 shows that electronic-based documents have higher level of organization than paper-based documents according to the respondents' opinions. This result reflects the abilities of practitioners to manage electronic documents effectively and successfully.



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Fig. 7. Comparison of the level of organization between paper-based and electronic-based documents in the construction projects.

141 3.3 Motivations and Challenges

142 The questionnaire respondents were asked to rank seven motivations and seven
 143 challenges for applying electronic DMS in the construction projects. Mean score
 144 method was used to rank the factors from the most important to the least important. The
 145 results are shown in Tables 1 and 2.

146 **Table 1.** Ranking of motivations for EDMS according to participants' opinions.

Motivations	Number of Respondents	Average Score	Rank
Reduce storage size	90	4.57	5
Enhance search and retrieval of information	90	4.78	1
Improve Ability to store documents for longer time	90	4.68	2
Enhance transfer and share of information	87	4.68	3
Improve problem solving and decision making	90	4.32	6
Improve ability to analyze data and discover conclusions and lessons learnt	89	4.28	7
Enhance learning process and training of junior engineers	89	4.58	4

147 **Table 2.** Ranking of challenges for EDMS according to participants' opinions.

Challenges	Number of Respondents	Average Score	Rank
Time pressure in construction projects	88	3.24	7
The high expected financial cost of electronic systems	88	4.06	1
Staff lack of skills for the use of electronic systems	87	3.92	2
Difficulty persuading the usefulness of its application	88	3.48	6
Lack of interest or awareness about EDMS	87	3.77	4
Unclear financial return for applying EDMS	87	3.77	5
Difficulty and unwillingness to change routine processes of work	87	3.83	3

148 The results in Table 1 show that according to the respondents' opinions the most
 149 motivating factor for applying electronic DMS in the construction projects is enhancing
 150 the process of searching and retrieving required information. This is followed by the
 151 motivations of saving important documents and files for longer time than in the existing
 152 paper-based systems, and enhancing transfer and share of important information.

153 The results in Table 2 show that the high expected financial cost is the most
 154 important challenge for implementing and applying EDMS in the construction projects.
 155 Also, the respondents think that the lack of staff skills for the use of EDMS and the

156 difficulty and unwillingness to change routine processes of work are very important
157 challenges for the successful implementation and application of EDMS.

158 **4 Conclusions**

159 Although the results showed that the use of documents in paper-based formats is more
160 common than electronic-based, it was noticed that the document management
161 practitioners have the awareness of EDMS importance and usefulness and have the
162 required skills and motives to apply it successfully. Their interest to enhance
163 information search and retrieval is the most important motivation for applying EDMS
164 in the construction projects. However, the need for a major investment of time, effort
165 and money, while benefits may need time to be noticed may stop construction
166 companies from adopting electronic systems. Another important barrier for EDMS
167 applications is that the organizations and personnel may be unwilling or unable to learn
168 the new methods and procedures accompanying the application of new systems. This
169 can be mitigated by applying user-friendly systems, and effective training and support.

170 Future research will aim at conducting more analysis of the questionnaire
171 considering the different types and sizes of construction projects. The results can help
172 understanding the different conditions, motivations and challenges of DMS in the
173 different construction projects. Future stages of the research will aim at developing and
174 applying a computerized DMS that integrates the different electronic systems in the
175 construction projects. The developed system will be evaluated and tested for the
176 applicability and usefulness in the construction projects of different sizes and types.

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